

PHILIPS

SONY

**SYSTEM DESCRIPTION COMPACT DISC DIGITAL AUDIO SYSTEM
SUBCODE/CONTROL AND DISPLAY SYSTEM,
CHANNELS R-W**

COMPACT
disc
DIGITAL AUDIO

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5. Channels R - W

5 Channels R - W

5.1 General data organization

5.1.1 Basic format

The available maximum data rate in the subcoding channels R to W is 43.2 kbits/sec.

The basic format is presented in Figure 5.1. The data is synchronized with the subcode sync patterns S0 and S1. Each group of 6 bits (R to W) is called a SYMBOL. A group of 24 SYMBOLS is called a PACK. A PACKET consists of 4 PACKS. The SYMBOL following the syncs S0 and S1 is the first SYMBOL of the first PACK in a PACKET.

To guard the data in the subcoding channels R to W, a (24, 20) REED-SOLOMON error correction code is used. To improve the burst error correction capability, 8 times interleaving is added to this error correction system.

The first two symbols in a PACK have additional protection with a (4, 2) REED SOLOMON error correction code.

The first symbol of a PACK contains a MODE switch of 3 bits and a 3 bit subdivision of MODE called ITEM.

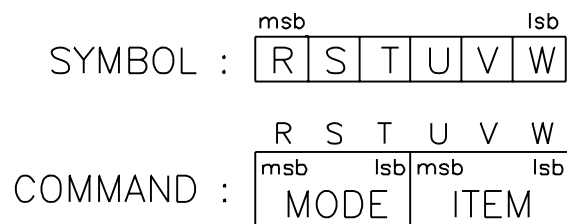
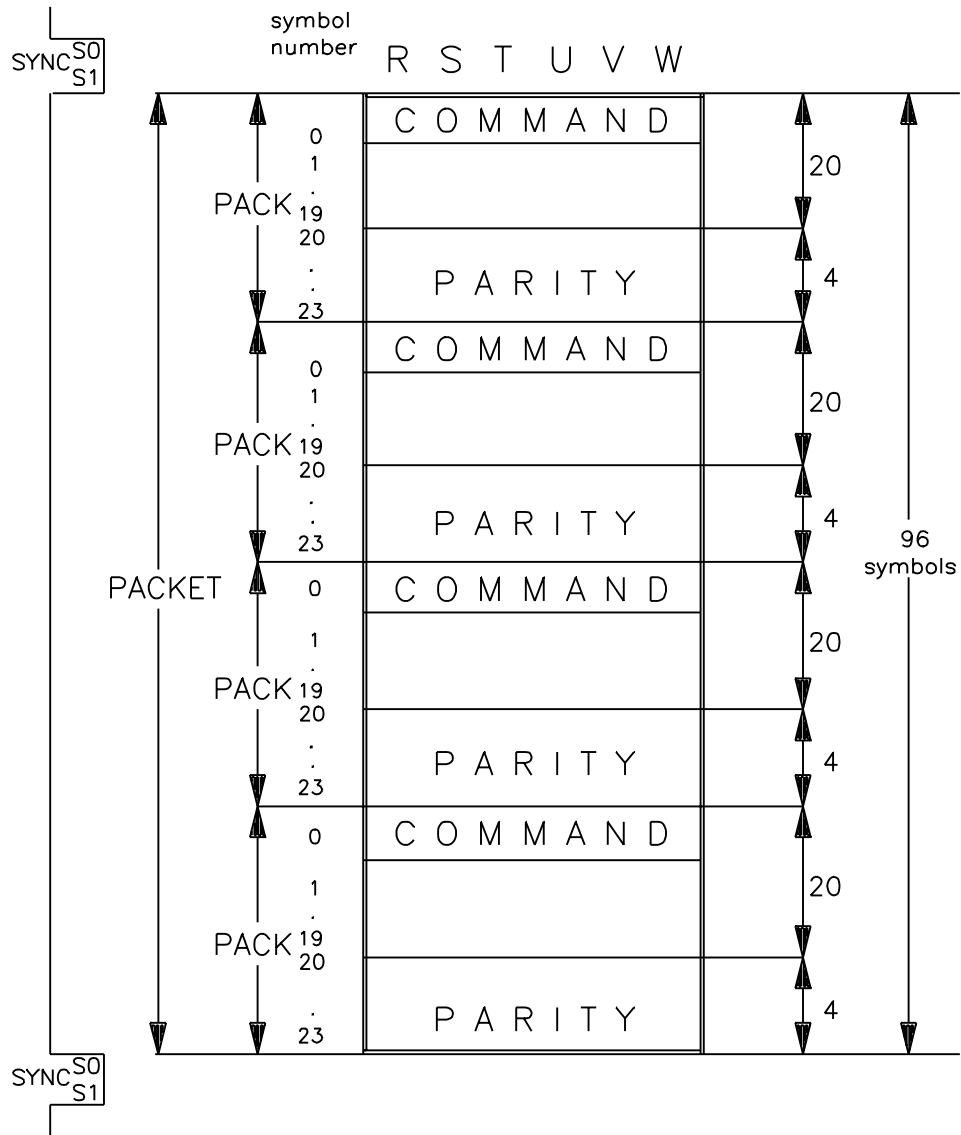
The defined MODE-ITEM combinations are:

MODE	ITEM	
0 (000)	0 (000)	: the ZERO mode
1 (001)	0 (000)	: the LINE-GRAPHICS mode
1 (001)	1 (001)	: the TV-GRAPHICS mode
1 (001)	2 (010)	: the EXTENDED-TV-GRAPHICS mode
3 (011)	0 (000)	: the MIDI mode
7 (111)	0 (000)	: the USER mode.

All MODE-ITEM combinations not defined are reserved for future use.

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Figure 5.1 Basic format Subcode Channels R-W



5. Channels R - W

5.1.2 PACK format

Figure 5.2 General organization of a PACK

Bit	R	S	T	U	V	W
Symbol 0	MODE			ITEM		
1	INSTRUCTION					
2	PARITY Q0 PARITY Q1					
3						
4	DATA field					
.						
.						
.						
.						
19						
20	PARITY P0 PARITY P1 PARITY P2 PARITY P3					
21						
22						
23						

INSTRUCTION : Describes the nature of the "DATA field"

PARITY Q : Error detection and correction on symbols 0 .. 3

PARITY P : Error detection and correction on symbols 0 .. 23.

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5.1.3 Error Correction Parity P

- (24, 20) Reed-Solomon code over GF (2⁶)
- Polynomial : P(X) = X⁶ + X + 1
- 1 symbol = 6 bits
- The parity matrix WH_p is:

$$H_p = \left\{ \begin{array}{ccccccc} 1 & 1 & 1 & . & . & . & 1 & 1 \\ a^{23} & a^{22} & a^{21} & . & . & . & a^1 & 1 \\ a^{46} & a^{44} & a^{42} & . & . & . & a^2 & 1 \\ a^{69} & a^{66} & a^{63} & . & . & . & a^3 & 1 \end{array} \right\}$$

- The primitive element a of GF(2⁶) is:

msb lsb
 a = (0 0 0 0 1 0)
- The parity symbols P0 = P - S_{24n+20}, P1 = P - S_{24n+21}, P2 = P - S_{24n+22} and P3 = P - S_{24n+23} are defined to satisfy the following equation:

$$H_p \cdot V_p = 0$$

with:

5. Channels R - W

$$V_p = \begin{bmatrix} D-S_{24n} \\ D-S_{24+1} \\ D-S_{24n+2} \\ D-S_{24n+3} \\ D-S_{24n+4} \\ D-S_{24n+5} \\ D-S_{24n+6} \\ D-S_{24n+7} \\ D-S_{24n+8} \\ D-S_{24n+9} \\ D-S_{24n+10} \\ D-S_{24n+11} \\ D-S_{24n+12} \\ D-S_{24n+13} \\ D-S_{24n+14} \\ D-S_{24n+15} \\ D-S_{24n+16} \\ D-S_{24n+17} \\ D-S_{24n+18} \\ D-S_{24n+19} \\ P-S_{24n+20} \\ P-S_{24n+21} \\ P-S_{24n+22} \\ P-S_{24n+23} \end{bmatrix}$$

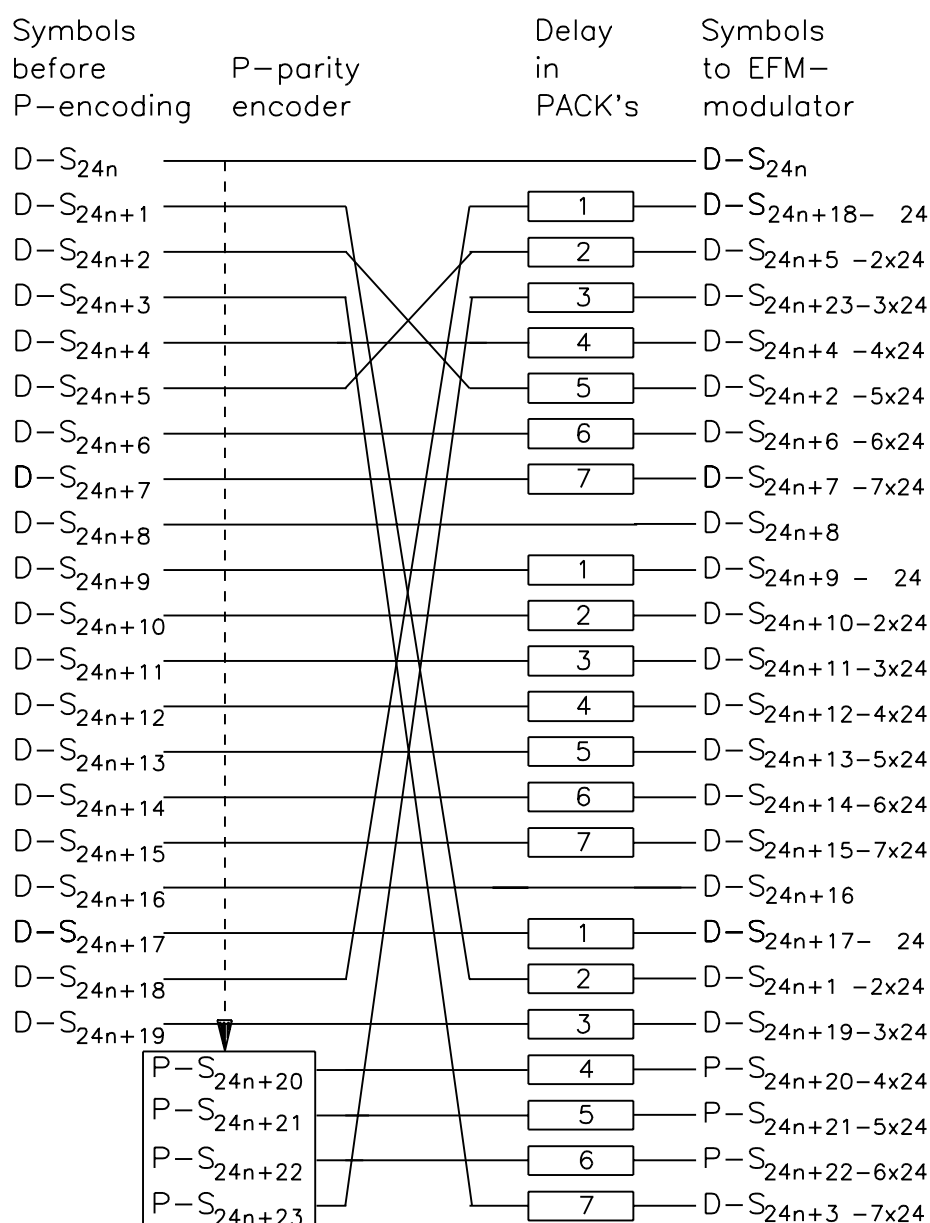
5.1.4 Interleaving

- The sequences of interleaving and de-interleaving are described in Figure 5.3 and Figure 5.4.
- The capacity of this interleaved error correction system is:
 - a. 8 symbol burst error correction on the disc with a single symbol correction strategy,
 - b. 16 symbol burst error correction on the disc with a two symbol correction strategy.

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5.1.5 P-parity encoder and interleave sequence

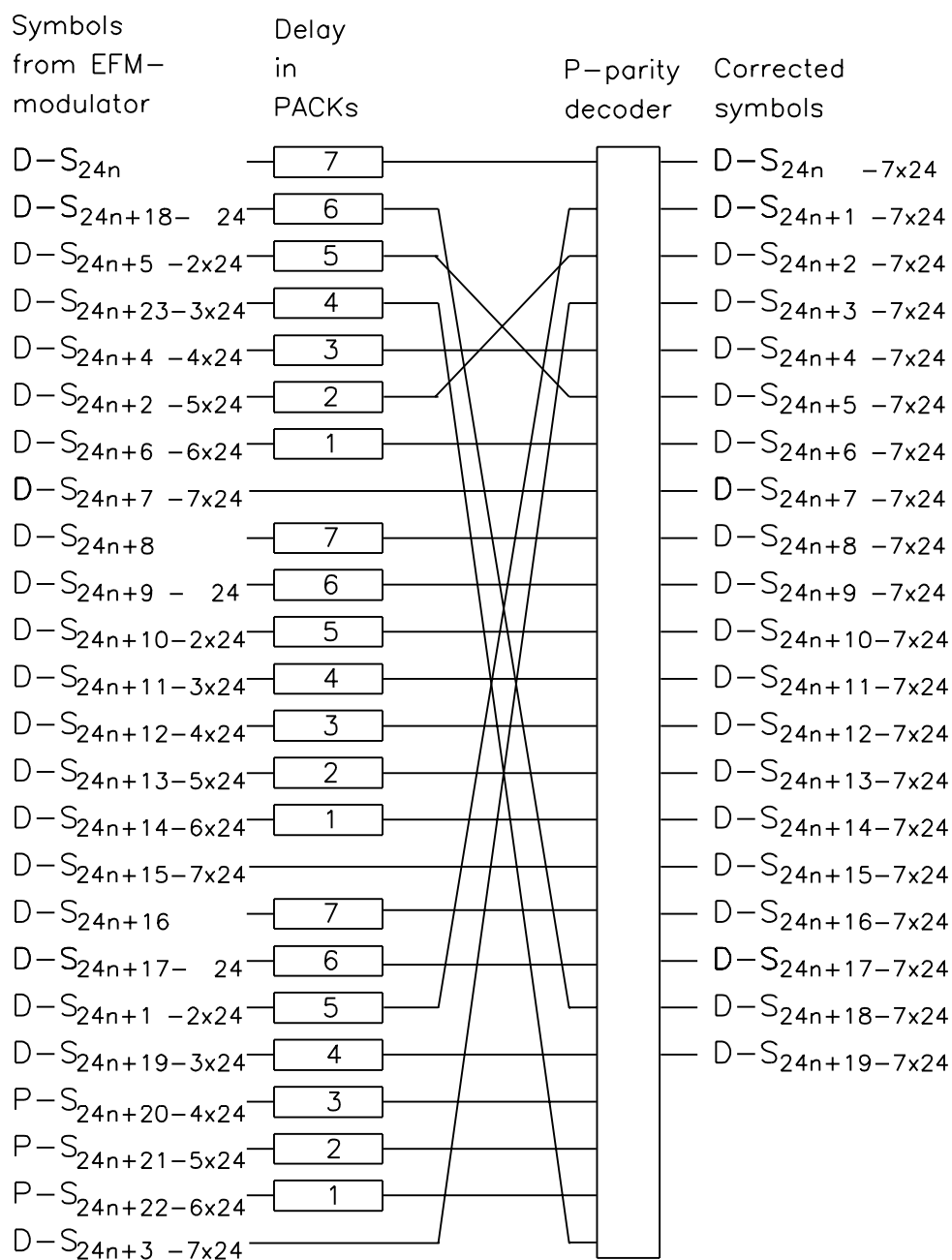
Figure 5.3 P-parity and interleave sequence



5. Channels R - W

5.1.6 P-parity decoder and de-interleave sequence

Figure 5.4 P-parity and de-interleave sequence



5. Channels R - W

5.1.7 Error correction parity Q

- (4, 2) Reed-Solomon code over $GF(2^6)$
- Polynomial: $P(X) = x^6 + X + 1$
- 1 symbol = 6 bits
- The parity matrix WH_q is:

$$H_q = \begin{pmatrix} 1 & 1 & 1 & 1 \\ a^3 & a^2 & a^1 & 1 \end{pmatrix}$$

- The primitive element a of $GF(2^6)$ is:

$\begin{matrix} \text{msb} & & & & \text{lsb} \\ a = (0 & 0 & 0 & 0 & 1 & 0) \end{matrix}$
- The parity symbols $Q0=D-S_{24n+2}$ and $Q1=D-S_{24n+3}$ are defined to satisfy the following equation:

$$H_q \cdot V_q = 0$$

with

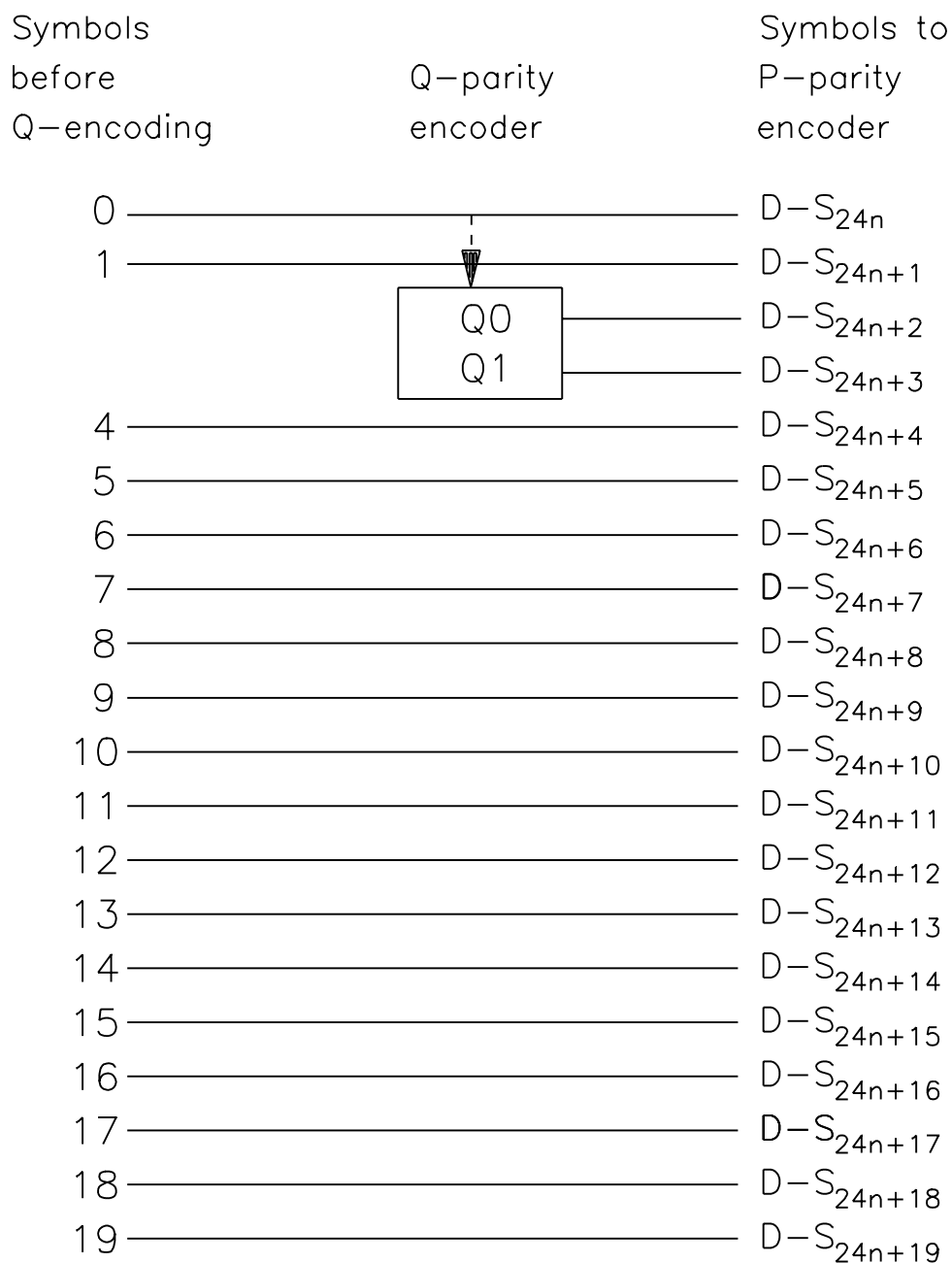
$$V_q = \begin{pmatrix} D-S_{24n} \\ D-S_{24n}+1 \\ D-S_{24n}+2 \\ D-S_{24n}+3 \end{pmatrix}$$

- This Q parity system combined with scrambling and interleaving can correct an error burst of 59 subcoding symbols on the disc by using a single symbol correcting strategy (symbols 0, 1, 2 and 3 only).

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5.1.8 Q-parity encoder

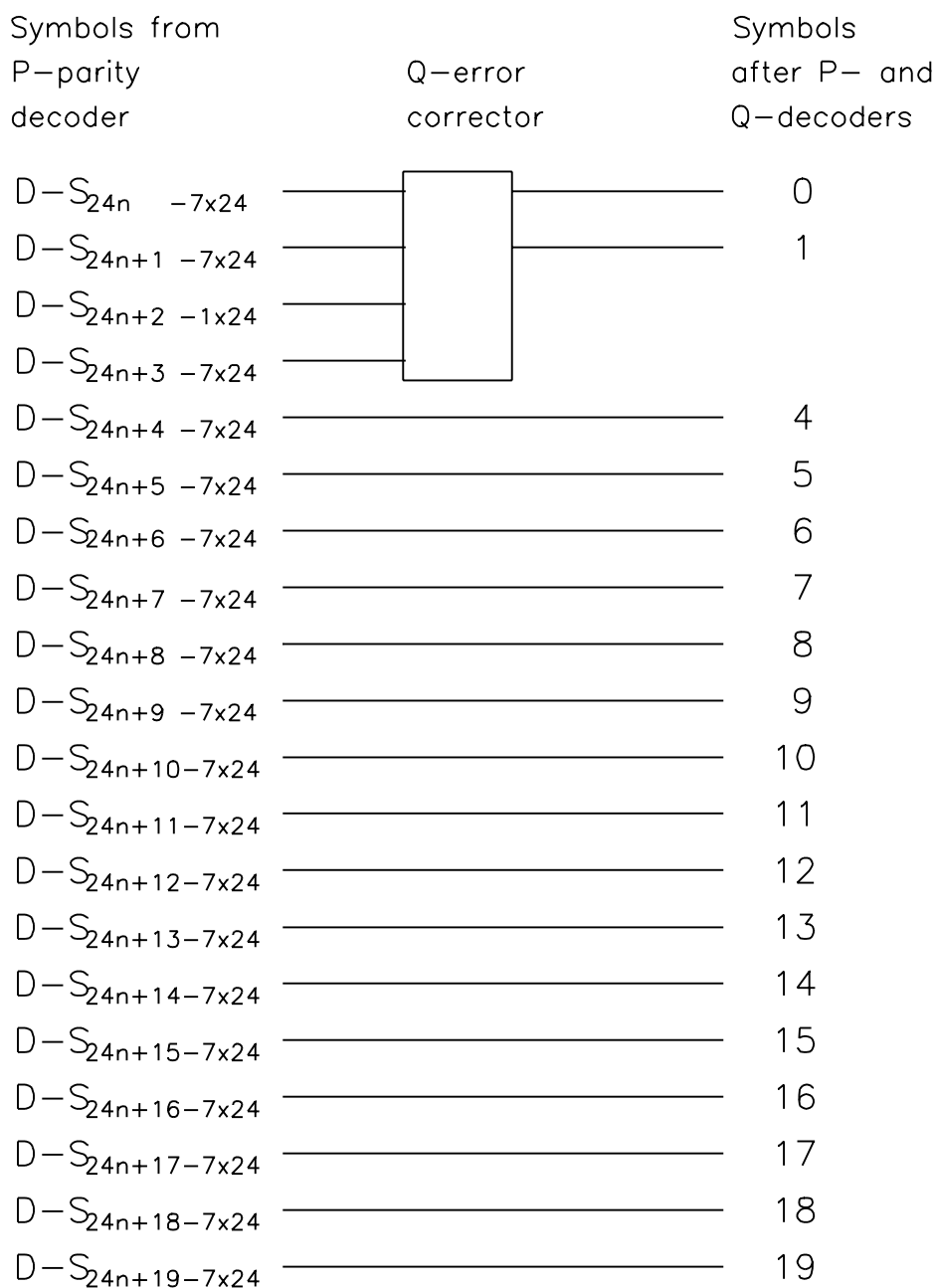
Figure 5.5 Q-parity encoder



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5.1.9 Q-parity decoder

Figure 5.6 Q-parity decoder



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5.2 The ZERO mode (MODE = 0, ITEM = 0)**5.2.1 General**

All bits in the PACK with this mode are zero. This mode is used for empty channel purposes. So, if no data is transferred in a PACK, the ZERO mode can be used.

5.2.2 The ZERO mode PACK format

The PACK format in the ZERO mode is:

Bits	R	S	T	U	V	W
Symbol 0	0	0	0	0	0	0
1	0	0	0	0	0	0
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
23	0	0	0	0	0	0

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5. Channels R - W

5.3 The LINE GRAPHICS mode: MODE = 1, ITEM = 0

5.3.1 General

The LINE-GRAPHICS system gives the possibility to display text and graphics pictures on a display with 288 (horizontal) x 24 (vertical) pixels. The data is displayed in a field of 48 (horizontal) x 2 (vertical) FONTS. A FONT is an array of 6 (horizontal) x 12 (vertical) pixels. A pixel is the smallest possible picture element.

The memory size of the display page is 50 x 4 FONTS. The outer ROWs and COLUMNs of the memory are intended for scroll actions. These ROWs and COLUMNs are not visible.

The data is displayed in monochrome. If a colour display device is available, the foreground and background colours in a FONT are chosen from 8 possible colours.

Instructions are available to:

- Write a FONT with 2 colours (foreground/background) into memory
- Soft scroll the SCREEN.

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5.3.2 The LINE-GRAPHICS mode PACK format

Bit	R	S	T	U	V	W
Symbol 0	0	0	1	0	0	0
1	INSTRUCTION					
2	PARITY Q0 PARITY Q1					
3						
4	DATA field					
.						
.						
.						
.						
19						
20	PARITY P0 PARITY P1 PARITY P2 PARITY P3					
21						
22						
23						

5. Channels R - W

5.3.3 The LINE-GRAPHICS mode FONT format

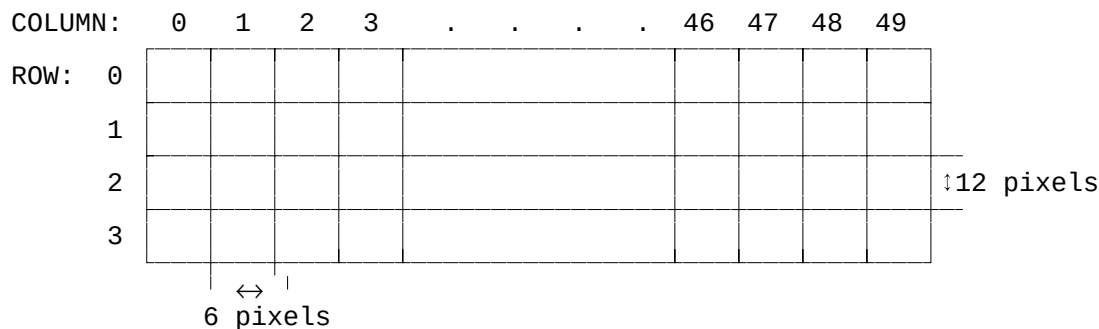
The location of the pixels in a FONT is:

Pixel-COLUMN	0	1	2	3	4	5	
Pixel-ROW 0							Pixel (0,0) is the upper-left pixel in a FONT
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

5. Channels R - W

5.3.4 The LINE-GRAPHICS mode SCREEN format

The visible part of the graphics memory is called the SCREEN area. The position (ROW, COLUMN) of the FONTs in the LINE-GRAPHICS memory is:



The graphics memory contains ROW 0 ... 3 and COLUMN 0 ... 49. The SCREEN area consists of 288 (horizontal) x 24 (vertical) pixels. The soft scroll pointers determine which pixel from FONT (1, 1) is the upper-left pixel from memory that is visible.

To facilitate soft scroll, screen pointers are available to define the shift (in pixels) on the screen of the data in memory. The following pointers are available:

- PH: (horizontal screen pointer) defines the horizontal shift in pixels of all pixel data in memory. The pixels with PIXEL-COLUMN=PH of FONTs (1 ... 3, 1) are the most left pixels from memory that are visible.
- PV: (vertical screen pointer) defines the vertical shift in pixels of all pixel data in memory. The pixels with PIXEL-ROW=PV of FONTs (1, 1 ... 49) are the upper pixels from memory that are visible.

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5.3.5 The LINE-GRAPHICS mode colour table

	(msb)		(lsb)		
	R	G	B		
0 =	0	0	0	:	black
1 =	0	0	1	:	blue
2 =	0	1	0	:	green
3 =	0	1	1	:	cyan
4 =	1	0	0	:	red
5 =	1	0	1	:	magenta
6 =	1	1	0	:	yellow
7 =	1	1	1	:	white

5.3.6 The LINE-GRAPHICS mode instructions

	R	S	T	U	V	W	
4 =	0	0	0	1	0	0	: Write FONT
12 =	0	0	1	1	0	0	: Soft scroll SCREEN

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5.3.6.1 Write FONT instruction (4)

If the instruction is 'Write FONT', the format of the DATA field in the PACK is:

Bit	R	S	T	U	V	W
Symbol 4	0	0	0	COL0		
5	0	0	0	COL1		
6	0	0	0	0	ROW	
7	COLUMN					lsb
8	y z FONT					
.						
.						
.						
.						
19						

COL0 : background colour number (see 5.3.5)
(lsb on bit W)

COL1 : foreground colour number (see 5.3.5)
(lsb on bit W)

ROW = 0... 3 (lsb on W) }
COLUMN = 0...49 (lsb on W) } memory address

FONT : y = top left pixel in the FONT
z = bottom right pixel in the FONT
Pixel with value = 0 : background colour (COL0)
1 : foreground colour (COL1)

The instruction 'Write FONT' writes the data defined in 'FONT' on address (ROW,COLUMN) into the LINE-GRAPHICS memory. On a monochrome display the pixels with value '0' are 'off' and the pixels with the value '1' are 'on'. On a colour display the pixels with value '0' are displayed with colour COL0 and the pixels with value '1' with colour COL1.

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5.3.6.2 Write Scroll SCREEN instruction (12)

If the instruction is 'Scroll SCREEN' the format of the DATA field in the PACK is:

Bit	R	S	T	U	V	W
Symbol 4	0	0	0	COLOR		
5	COPH		0	PH		
6	COPV		PV			
7	0	0	0	0	0	0
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
19	0	0	0	0	0	0

COLOR : background colour number (see 5.3.5)
(lsb on bit W)

COPH = 0 : No horizontal copy
 = 1 : Copy right
 = 2 : Copy left
 (lsb on bit S)

PH = 0 .. 5 (lsb on bit W): horizontal shift pointer (in pixels)

COPV = 0 : No vertical copy
 = 1 : Copy down
 = 2 : Copy up
 (lsb on bit S)

PV = 0 .. 11 (lsb on bit W): vertical shift pointer (in pixels)

5. Channels R - W

The instruction 'Scroll SCREEN' gives new values to the screen pointers PH and PV. The screen pointer PH is given the new value "PH" and the screen pointer PV is given the new value "PV", for all values of Copenh and COPV. Depending on the values of Copenh and COPV, all FONTS can be copied to the next (or previous) ROW and COLUMN positions.

If Copenh=1 (scroll right) then all FONTS are shifted one COLUMN to the right in memory. The contents of FONT (i,j) is copied to position (i,j+1) for i=0..3 and j=0..48. The original data of positions (i,49) is lost (i=0..3). On a monochrome display the FONTS with position (i,0) are set to background and on a colour display these FONTS are set to the colour defined in COLOR (i=0..3).

If Copenh=2 (scroll left) then all FONTS are shifted one COLUMN to the left in memory. The contents of FONT (i,j) is copied to position (i,j-1) for i=0..3 and j=1..49. The original data of positions (i,0) is lost (i=0..3). On a monochrome display the FONTS with position (i,49) are set to background and on a colour display these FONTS are set to the colour defined in COLOR (i=0..3).

If COPV=1 (scroll down) then all FONTS are shifted one ROW down in memory. The contents of FONT (i,j) is copied to position (i+1,j) for i=0..2 and j=0..49. The original data of positions (3,j) is lost (j=0..49). On a monochrome display the FONTS with position (0,j) are set to background, on a colour display these FONTS are set to the colour defined in COLOR (j=0..49)

If COPV=2 (scroll up) then all FONTS are shifted one ROW up in memory. The contents of FONT (i,j) is copied to position (i-1,j) for i=1..3 and j=0..49. The original data for positions (0,j) is lost (j=0..49). On a monochrome display the FONTS with position (3,j) are set to background, on a colour display these FONTS are set to the colour defined in COLOR (j=0..49)

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5.4 The TV-GRAPHICS mode (MODE = 1, ITEM = 1)

5.4.1 General

The TV GRAPHICS system gives the possibility to display text and graphics pictures. The data is displayed in a field of 48 (horizontal) x 16 (vertical) FONTS. A FONT is an array of 6 (horizontal) x 12 (vertical) pixels. A pixel is the smallest possible picture element.

The memory size of the display page is 50 x 18 FONTS. The outer ROWs and COLUMNs of the memory are intended for scroll actions. These ROWs and COLUMNs are not visible.

The display area outside the visible part of 48 x 16 FONTS can be preset with a colour. This area is called the BORDER.

The FONT data is provided with a 'channel' number (0 .. 15). This channel number gives a decoder the (optional) possibility to select a specific part of the incoming data. If no channel selector is available, the channels '0' and '1' are displayed. With a selector, a combination can be made from all available channels.

The data is displayed in maximum 16 colours. These 16 colours are defined in a C(olour) L(ook) U(p) T(able) of 16 x 12 bits. The colours of the CLUT can be chosen from a maximum of 4096 (12 bits in RED, GREEN and BLUE, 4 bits each). The CLUT is loaded from the disc.

INSTRUCTIONS are available to:

- Preset the memory with a colour
- Preset the border with a colour
- Write a FONT with 2 colours (foreground/background) into memory
- EXCLUSIVE-OR a FONT with 2 colours
- Load the CLUT. Load the colour '0 ... 7' and '8 ... 15'.
- Soft scroll the SCREEN.
- Define colour transparency

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5.4.2 The TV GRAPHICS mode PACK format

Bit	R	S	T	U	V	W
Symbol 0	0	0	1	0	0	1
1	INSTRUCTION					
2	PARITY Q0 PARITY Q1					
3						
4	DATA field					
.						
.						
.						
.						
19						
20	PARITY P0 PARITY P1 PARITY P2 PARITY P3					
21						
22						
23						

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5.4.3 The TV-GRAPHICS mode FONT format

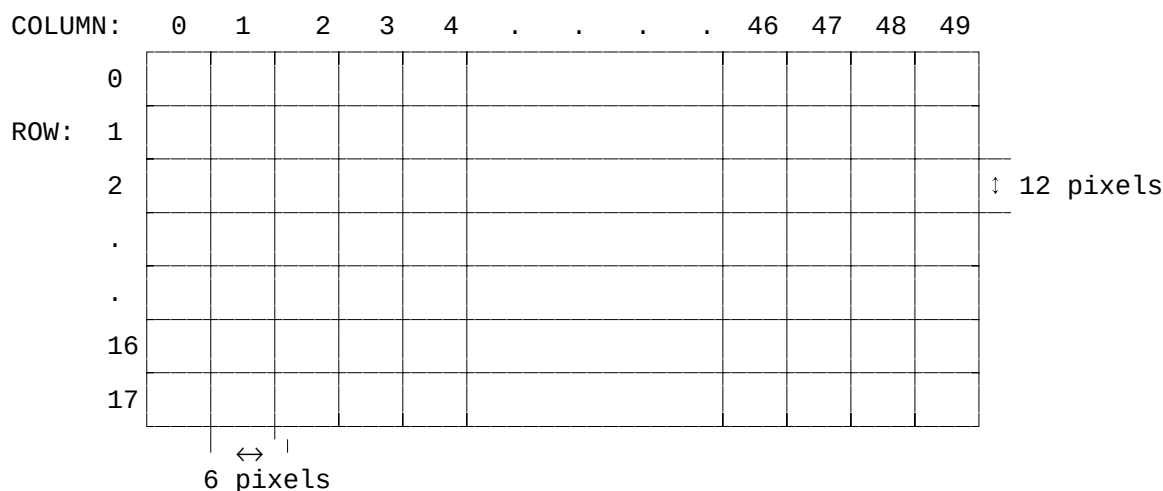
The location of the pixels in a FONT is:

Pixel-COLUMN		0	1	2	3	4	5	
Pixel-ROW	0							Pixel (0,0) is the upper-left pixel in a FONT
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							

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5.4.4 The TV-GRAPHICS mode SCREEN format

The visible part of the graphics memory is called the SCREEN area. The position (ROW, COLUMN) of the FONTS in the TV-GRAPHICS memory is:



The graphics memory contains ROW 0 .. 17 and COLUMN 0 .. 49. The SCREEN area consists of 288 (horizontal) x 192 (vertical) pixels. The soft scroll pointers determine which pixel from FONT (1, 1) is the left-upper pixel from memory that is visible.

The graphics memory consists of four 1-bit planes (plane 0 .. 3). Bit plane 0 is the bit plane with the least significant bits (lsb) of the pixels and bit plane 3 the bitplane with the most significant bits (msb) of the pixels.

To facilitate soft scroll, screen pointers are available to define the shift (in pixels) on the screen of the data in memory. The following pointers are available:

- PH: (horizontal screen pointer) defines the horizontal shift in pixels of all pixel data in memory. The pixels with Pixel-COLUMN=PH of FONTS (1 .. 17, 1) are the most left pixels from memory that are visible.
- PV: (vertical screen pointer) defines the vertical shift in pixels of all pixel data in memory. The pixels with Pixel-ROW=PV of FONTS (1, 1 .. 49) are the upper pixels from memory that are visible.

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5.4.5 The TV-GRAPHICS mode INSTRUCTIONS

	<u>R</u>	<u>S</u>	<u>T</u>	<u>U</u>	<u>V</u>	<u>W</u>	
1	=	0	0	0	0	0	1 : Preset MEMORY ¹
2	=	0	0	0	0	1	0 : Preset BORDER
6	=	0	0	0	1	1	0 : Write FONT FOREGROUND/BACKGROUND
20	=	0	1	0	1	0	0 : Soft scroll SCREEN with preset
24	=	0	1	1	0	0	0 : Soft scroll SCREEN with copy
28	=	0	1	1	1	0	0 : Define Colour transparency
30	=	0	1	1	1	1	0 : Load CLUT Colour 0 .. colour 7
31	=	0	1	1	1	1	1 : Load CLUT Colour 8 .. colour 15
38	=	1	0	0	1	1	0 : EXCLUSIVE-OR FONT with 2 colours.

¹ The Preset Memory instruction is repeated on disc 16 times in succeeding PACKS.

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5.4.5.1 Preset MEMORY instruction (1)

If the instruction is 'Preset MEMORY', the format of the DATA field in the PACK is:

Bit	R	S	T	U	V	W
Symbol 4	0	0	COLOR			
5	0	0	REPEAT			
6	0	0	0	0	0	0
.	.					.
.	.					.
.	.					.
.	.					.
19	0	0	0	0	0	0

COLOR = Colour number 0 .. 15 (lsb on W)

REPEAT = 0 .. 15 (lsb on bit W)

The instruction 'Preset MEMORY' presets all FONTS in the MEMORY with the colour defined in COLOR. In addition to this, the scroll pointers PH and PV are reset to zero.

This instruction is repeated on the disc 16 times in succeeding PACKS. The value of REPEAT gives the sequence number of the 'Preset MEMORY' instruction. In the first 'Preset MEMORY' PACK from a sequence of 16 the value of REPEAT is zero. The value of REPEAT increases with one in the succeeding PACKS of a sequence.

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5.4.5.2 Preset BORDER instruction (2)

If the instruction is 'Preset BORDER', the format of the DATA field in the PACK is:

Bit	R	S	T	U	V	W
Symbol 4	0	0	COLOR			
5	0	0	0	0	0	0
6	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
19	0	0	0	0	0	0

COLOR = Colour number 0 .. 15 (lsb on W)

The instruction 'Preset BORDER' presets the BORDER area of the display with the colour defined in COLOR.

5. Channels R - W

5.4.5.3 Write FONT FOREGROUND/BACKGROUND instruction (6)

If the instruction is 'Write FONT FOREGROUND/BACKGROUND', the format of the DATA field in the PACK is:

Bit	R	S	T	U	V	W
Symbol 4	CH 0		COLOR0			
5	CH 1		COLOR1			
6	0	ROW				lsb
7	COLUMN					lsb
8	y FONT z					
.						
.						
.						
.						
.						
19						

COLOR0 : background colour number 0 .. 15 (lsb on W)

COLOR1 : foreground colour number 0 .. 15 (lsb on W)

ROW = 0 .. 17
 COLUMN = 0 .. 49 } memory address of FONT

CH0/1 = 0 ..15: channel number
 (msb on R of symbol 4, lsb on S of symbol 5)

FONT : y = top left pixel in the FONT
 z = bottom right pixel in the FONT
 Pixel with value = 0 : background colour (COLOR0)
 1 : foreground colour (COLOR1)
 COLOR0/1 : lsb = bit plane 0
 msb = bit plane 3

5. Channels R - W

The instruction 'Write FONT FOREGROUND/BACKGROUND' writes one FONT with the data defined in 'FONT' and the colours COLOR0 and COLOR1 into memory. The data in FONT is written on address (ROW, COLUMN) in bit planes 0 .. 3 of the graphics memory.

The number CH gives a channel number to a FONT with data. Channels 0 and 1 contain the default picture (a decoder without a channel selector ignores all 'Write FONT' instructions with CH 2 .. 15). If a decoder is equipped with a channel selector, all channels can be switched on or off selectively.

5. Channels R - W

5.4.5.4 Scroll SCREEN with preset instruction (20)

If the instruction is 'Scroll SCREEN with preset' the format of the DATA field in the PACK is:

Bit	R	S	T	U	V	W
Symbol 4	0	0	COLOR			
5	COPH		0	PH		
6	COPV		PV			
7	0	0	0	0	0	0
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
19	0	0	0	0	0	0

COLOR : Colour number 0 .. 15 (lsb on bit W)

COPH = 0 : No horizontal copy
 = 1 : Copy right
 = 2 : Copy left
 (lsb on bit S)

PH = 0 .. 5 (lsb on bit W): horizontal shift pointer (in pixels)

COPV = 0 : No vertical copy
 = 1 : Copy down
 = 2 : Copy up
 (lsb on bit S)

PV = 0 .. 11 (lsb on bit W): vertical shift pointer (in pixels)

5. Channels R - W

The instruction 'Scroll SCREEN, with preset', gives new values to the screen pointers PH and PV. The screen pointer PH is given the new value "PH" and the screen pointer PV is given the new value "PV", for all values of CPH and COPV. Depending on the values of CPH and COPV, all FONTS can be copied to the next (or previous) ROW and COLUMN positions.

If CPH=1 (scroll right) then all FONTS are shifted one COLUMN to the right in memory. The contents of FONT (i,j) is copied to position (i,j+1) for i=0..17 and j=0..48. The original data of positions (i,49) is lost (i=0..17). The FONTS with position (i,0) are preset with the colour defined in COLOR (i=0..17).

If CPH=2 (scroll left) then all FONTS are shifted one COLUMN to the left in memory. The contents of FONT (i,j) is copied to position (i,j-1) for i=0..17 and j=1..49. The original data of positions (i,0) is lost (i=0..17). The FONTS with position (i,49) are preset with the colour defined in COLOR (i=0..17).

If COPV=1 (scroll down) then all FONTS are shifted one ROW down in memory. The contents of FONT (i,j) is copied to position (i+1,j) for i=0..16 and j=0..49. The original data of positions (17,j) is lost (j=0..49). The FONTS with position (0,j) are preset with the color defined in COLOR (j=0..49).

If COPV=2 (scroll up) then all FONTS are shifted one ROW up in memory. The contents of FONT (i,j) is copied to position (i-1,j) for i=1..17 and j=0..49. The original data of positions (0,j) is lost (j=0..49). The FONTS with position (17,j) are preset with the colour defined in COLOR (j=0..49).

5. Channels R - W

5.4.5.5 Scroll SCREEN with copy instruction (24)

If the instruction is 'Scroll SCREEN with copy' the format of the DATA field in the PACK is:

Bit	R	S	T	U	V	W
Symbol 4	0	0	0	0	0	0
5	COPH		0	PH		
6	COPV		PV			
7	0	0	0	0	0	0
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
.	.					.
19	0	0	0	0	0	0

COPH = 0 : No horizontal copy
 = 1 : Copy right
 = 2 : Copy left
 (lsb on bit S)

PH = 0 .. 5 (lsb on bit W): horizontal shift pointer (in pixels)

COPV = 0 : No vertical copy
 = 1 : Copy down
 = 2 : Copy up
 (lsb on bit S)

PV = 0 .. 11 (lsb on bit W): vertical shift pointer (in pixels)

5. Channels R - W

The instruction 'Scroll SCREEN, with copy', gives new values to the screen pointers PH and PV. The screen pointer PH is given the new value "PH" and the screen pointer PV is given the new value "PV", for all values of CPH and COPV. Depending on the values of CPH and COPV, all FONTS can be copied to the next (or previous) ROW and COLUMN positions. The 'with copy' clause in this instruction causes the pixel memory to be wrap-around.

If CPH=1 (scroll right) then all FONTS are shifted one COLUMN to the right in memory. The contents of FONT (i,j) is copied to position (i,j+1) for i=0..17 and j=0..48. The original data of the FONTS (i,49) is copied to position (i,0) for i=0..17.

If CPH=2 (scroll left) then all FONTS are shifted one COLUMN to the left in memory. The contents of FONT (i,j) is copied to position (i,j-1) for i=0..17 and j=1..49. The original data of the FONTS (i,0) is copied to position (i,49) for i=0..17.

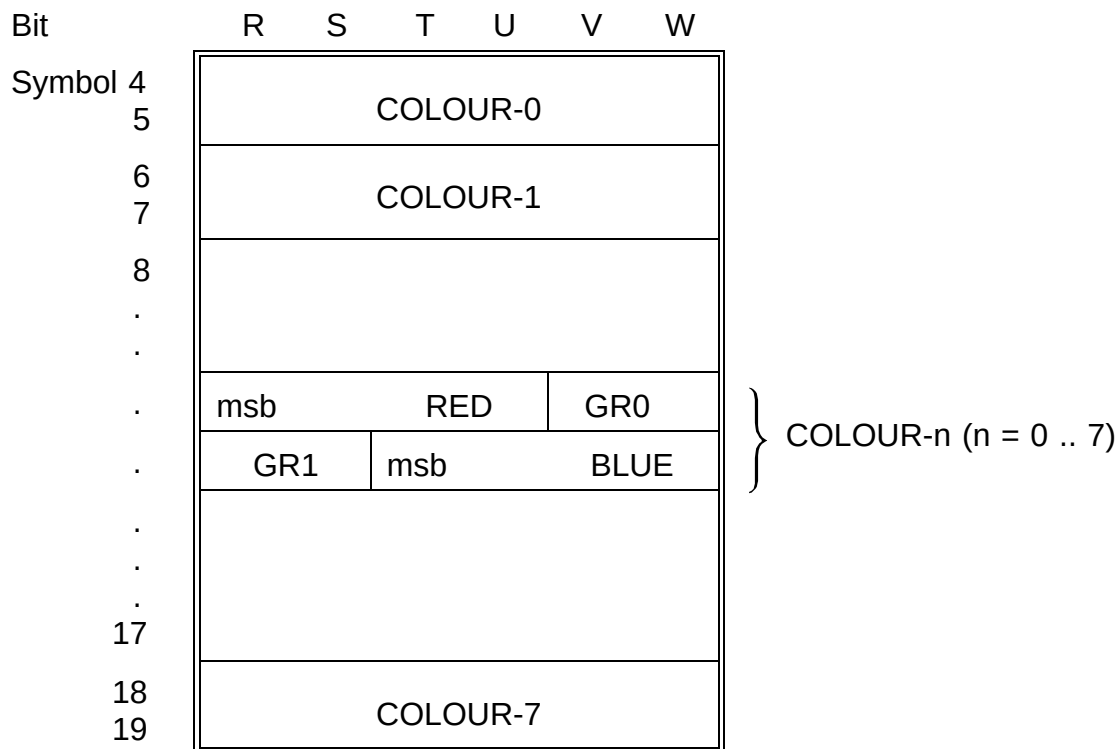
If COPV=1 (scroll down) then all FONTS are shifted one ROW down in memory. The contents of FONT (i,j) is copied to position (i+1,j) for i=0..16 and j=0..49. The original data of the FONTS (17,j) is copied to position (0,j) for j=0..49.

If COPV=2 (scroll up) then all FONTS are shifted one ROW up in memory. The contents of FONT (i,j) is copied to position (i-1,j) for i=1..17 and j=0..49. The original data of the FONTS (0,j) is copied to position (17,j) for j=0..49.

5. Channels R - W

5.4.5.6 Load CLUT Colour-0 .. 7 instruction (30)

If the instruction is 'Load CLUT Colour-0..7' the format of the DATA field in the PACK is:



RED	:	red component	(msb on bit R)	}	(even symbols)
GR0	:	} green component	(msb on bit V)		
GR1	:		(lsb on bit S)	}	(odd symbols)
BLUE	:	blue component	(msb on bit T)		

The instruction 'Load CLUT Colour-0..7' gives with a 12-bit code the first half (colour-0..7) of the Colour Look Up Table.

The encoding of the colours is R, G, B, 4 bits each. These 4 bits give the intensity (linear encoded) of Red, Green and Blue:

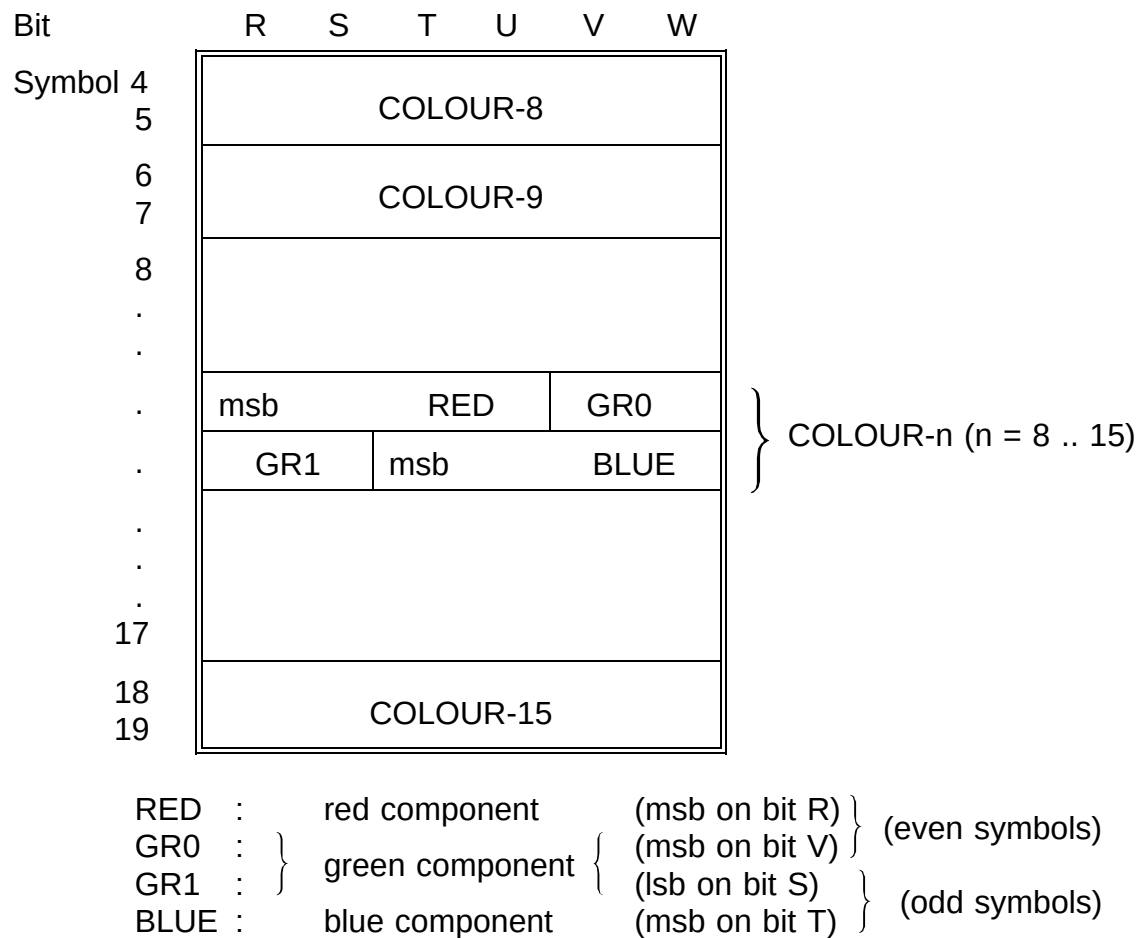
Minimum intensity: 0 = 0 0 0 0

Maximum intensity: 15 = 1 1 1 1

5. Channels R - W

5.4.5.7 Load CLUT Colour-8 .. 15 instruction (31)

If the instruction is 'Load CLUT colour-8..15' the format of the DATA field in the PACK is:



The instruction 'Load CLUT Colour (8..15)' gives with a 12-bit code the second half (colour-8..15) of the Colour Look Up Table.

The encoding of the colours is R, G, B, 4 bits each. These 4 bits give the intensity (linear encoded) of Red, Green and Blue:

Minimum intensity: 0 = 0 0 0 0

Maximum intensity: 15 = 1 1 1 1

5.4.5.8 EXCLUSIVE-OR FONT instruction (38)

Bit	R	S	T	U	V	W
Symbol 4	CH 0		COLOR0			
5	CH 1		COLOR1			
6	0	ROW				lsb
7	COLUMN					lsb
8	y FONT z					
.						
.						
.						
.						
19						

FONT : y = top left pixel in the FONT
z = bottom right pixel in the FONT
Pixel with value = 0 : X-OR the colour number of this pixel with the number "COLOR0"
1 : X-OR the colour number of this pixel with the number "COLOR1"

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5. Channels R - W

The number CH gives a channel number to a FONT with data. Channels 0 and 1 contain the default picture (a decoder without channel selector ignores all 'EXCLUSIVE-OR FONT' instructions with CH=2..15). If a decoder is equipped with a channel selector, all channels can be switched on or off selectively.

If a pixel in FONT has value '0', the 4 bits in the memory for this pixel are X-ORed with the 4 bits given in COLOR0. If a pixel in FONT has value '1', the 4 bits in the memory for this pixel are X-ORed with the 4 bits given in COLOR1.

5. Channels R - W

5.4.5.9 Define Colour Transparency instruction (28)

If the instruction is 'Define Colour Transparency' the format of the DATA field in the PACK is:

Bit	R	S	T	U	V	W
Symbol 4	TRANS0					
5	TRANS1					
6	TRANS2					
.						
.						
18	TRANS14					
19	TRANS15					

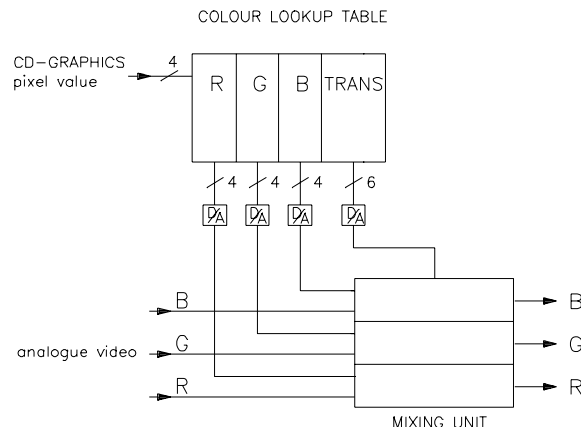
TRANSn: binary values of 0 ..63 (lsb on bit W)
n: colour number (0..15)

The values of the TRANSn words of the instruction 'Define Colour Transparency' define the transparency level of each of the sixteen colours specified in the CLUT. A pixel is mixed with the video according to the following rule: contribution of graphics is $(63 - \text{TRANSn}/63)$ of the graphics output level, contribution of analogue video is $\text{TRANSn}/63$ of the video output level for Red, Green and Blue.

The colour transparency option is intended for creating overlays on video and for fading between graphics and video. Non-linearities of the fader hardware are allowed. A block diagram for a video/graphics mixing unit is shown in figure 5.6.

At system reset the transparency of all colours is 0 (= non-transparent).

Figure 5.6 Block diagram of a video/graphics mixing unit



5. Channels R .. W

5.5 The EXTENDED TV-GRAPHICS MODE (MODE = 1, ITEM = 1 & 2)

5.5.1 General

The EXTENDED TV-GRAPHICS system allows presentation of natural pictures and video effects, such as cut and dissolve.

The EXTENDED TV-GRAPHICS mode is realized by combining MODE-1, ITEM-1 (the TV-GRAPHICS mode, see 5.4) with MODE-1, ITEM-2.

The TV-GRAPHICS system and the EXTENDED TV-GRAPHICS system are completely backward and forward compatible.

The EXTENDED TV-GRAPHICS system uses two graphics memories, which can be used as one 8-bit memory plane ('1-plane state') to present a 256-colour CLUT (Colour Look Up Table) picture, or can be used as two independent 4-bit memory planes ('2-plane state') to present two 16-colour CLUT pictures. In the last case, cut and dissolve effects can be arranged between two 16-colour CLUT pictures. The CLUTs are loaded from the disc.

The PRIMARY MEMORY is used for the FONT data like the TV-GRAPHICS memory. The SECONDARY MEMORY is used for the FONT data or for the Additional FONT data, adding 16 colours to each 16 colour number in the PRIMARY MEMORY. In the '1-plane state' an 8-bit code defines one of the 256 colour numbers. The least significant 4 bits of the 8-bit code are in the PRIMARY MEMORY and the most significant 4 bits of the 8-bit code are in the SECONDARY MEMORY. The colours of the CLUT can be chosen from a maximum of 262144 colours (256 x 18 bits, R,G,B, 6 bits each).

The display resolution is the same as for TV-GRAPHICS.

The PRIMARY MEMORY and the SECONDARY MEMORY and both BORDERS have the same size of the display page and the display area as the memory of the TV-GRAPHICS system.

The FONT-data and the Additional FONT data are provided with a 'channel' number (0 .. 15). The use of channel numbers is the same as in the TV-GRAPHICS system.

5. Channels R .. W

An EXTENDED TV-GRAPHICS decoder shall process both ITEM-1 and ITEM-2 instructions.

ITEM-2 instructions are available to:

- MEMORY Control.
- Write Additional FONT with 2 levels (foreground/background).
- EXCLUSIVE-OR Additional FONT with 2 levels.
- Load CLUT. Load the upper 4 bits from R,G,B, 6 bits each. 8 colours can be loaded per instruction.
- Load Additional CLUT. Loads the lower 2 bits from R,G,B, 6 bits each. Combined with 'Load CLUT'.

5. Channels R .. W

5.5.2 EXTENDED TV-GRAPHICS mode PACK format:

Bit	R	S	T	U	V	W
Symbol 0	0	0	1	ITEM		
1	INSTRUCTION					
2	PARITY Q0 PARITY Q1					
3						
4	DATA field					
.						
.						
19						
20	PARITY P0 PARITY P1 PARITY P2 PARITY P3					
21						
22						
23						

ITEM = 1 or 2 = (001) or (010)

ITEM = 1 or 2 = (001) or (010)

5.5.3 EXTENDED TV-GRAPHICS mode FONT format

The FONT format is the same as for TV-GRAPHICS. (See 5.4).

5.5.4 EXTENDED TV-GRAPHICS mode SCREEN and MEMORY formats.

The definition of the SCREEN/BORDER area and the position [ROW, COLUMN] of a FONT is the same as for TV-GRAPHICS.

FONT data and Additional FONT data is written in the same position [ROW,COLUMN] of each memory.

When Additional FONT data exists in the SECONDARY MEMORY, the FONTs of both memories are shifted together by the instruction 'Soft scroll SCREEN'.

5.5.5 EXTENDED TV-GRAPHICS mode instructions

ITEM-1 instructions are described in 5.4.

These instructions are affecting the memory directed by the 'MEMORY control' instruction.

5. Channels R .. W

ITEM-2 instructions:

3 = 0 0 0 0 1 1 : MEMORY control¹.
 6 = 0 0 0 1 1 0 : Write Additional FONT FOREGROUND/BACKGROUND.
 14 = 0 0 1 1 1 0 : EXCLUSIVE-OR Additional FONT with 2 colours.
 16 = 0 1 0 0 0 0 : Load CLUT Colour-0..7 (each colour 4 bits)
 17 = 0 1 0 0 0 1 : Load CLUT Colour-8..15 (each colour 4 bits)
 18 = 0 1 0 0 1 0 : Load CLUT Colour-16..23 (each colour 4 bits)
 19 = 0 1 0 0 1 1 : Load CLUT Colour-24..31 (each colour 4 bits)
 20 = 0 1 0 1 0 0 : Load CLUT Colour-32..39 (each colour 4 bits)
 21 = 0 1 0 1 0 1 : Load CLUT Colour-40..47 (each colour 4 bits)
 22 = 0 1 0 1 1 0 : Load CLUT Colour-48..55 (each colour 4 bits)
 23 = 0 1 0 1 1 1 : Load CLUT Colour-56..63 (each colour 4 bits)
 24 = 0 1 1 0 0 0 : Load CLUT Colour-64..71 (each colour 4 bits)
 25 = 0 1 1 0 0 1 : Load CLUT Colour-72..79 (each colour 4 bits)
 26 = 0 1 1 0 1 0 : Load CLUT Colour-80..87 (each colour 4 bits)
 27 = 0 1 1 0 1 1 : Load CLUT Colour-88..95 (each colour 4 bits)
 28 = 0 1 1 1 0 0 : Load CLUT Colour-96..103 (each colour 4 bits)
 29 = 0 1 1 1 0 1 : Load CLUT Colour-104..111 (each colour 4 bits)
 30 = 0 1 1 1 1 0 : Load CLUT Colour-112..119 (each colour 4 bits)
 31 = 0 1 1 1 1 1 : Load CLUT Colour-120..127 (each colour 4 bits)
 32 = 1 0 0 0 0 0 : Load CLUT Colour-128..135 (each colour 4 bits)
 33 = 1 0 0 0 0 1 : Load CLUT Colour-136..143 (each colour 4 bits)
 34 = 1 0 0 0 1 0 : Load CLUT Colour-144..151 (each colour 4 bits)
 35 = 1 0 0 0 1 1 : Load CLUT Colour-152..159 (each colour 4 bits)
 36 = 1 0 0 1 0 0 : Load CLUT Colour-160..167 (each colour 4 bits)
 37 = 1 0 0 1 0 1 : Load CLUT Colour-168..175 (each colour 4 bits)
 38 = 1 0 0 1 1 0 : Load CLUT Colour-176..183 (each colour 4 bits)
 39 = 1 0 0 1 1 1 : Load CLUT Colour-184..191 (each colour 4 bits)
 40 = 1 0 1 0 0 0 : Load CLUT Colour-192..199 (each colour 4 bits)
 41 = 1 0 1 0 0 1 : Load CLUT Colour-200..207 (each colour 4 bits)
 42 = 1 0 1 0 1 0 : Load CLUT Colour-208..215 (each colour 4 bits)
 43 = 1 0 1 0 1 1 : Load CLUT Colour-216..223 (each colour 4 bits)
 44 = 1 0 1 1 0 0 : Load CLUT Colour-224..231 (each colour 4 bits)
 45 = 1 0 1 1 0 1 : Load CLUT Colour-232..239 (each colour 4 bits)
 46 = 1 0 1 1 1 0 : Load CLUT Colour-240..247 (each colour 4 bits)
 47 = 1 0 1 1 1 1 : Load CLUT Colour-248..255 (each colour 4 bits)

(continued)

¹ The MEMORY control instruction is repeated in the disc twice in succeeding packs.

5. Channels R .. W

(continued)

48 = 1 1 0 0 0 0 :	Load CLUT Additional Colour-0..15	(each colour 2 bits)
49 = 1 1 0 0 0 1 :	Load CLUT Additional Colour-16..31	(each colour 2 bits)
50 = 1 1 0 0 1 0 :	Load CLUT Additional Colour-32..47	(each colour 2 bits)
51 = 1 1 0 0 1 1 :	Load CLUT Additional Colour-48..63	(each colour 2 bits)
52 = 1 1 0 1 0 0 :	Load CLUT Additional Colour-64..79	(each colour 2 bits)
53 = 1 1 0 1 0 1 :	Load CLUT Additional Colour-80..95	(each colour 2 bits)
54 = 1 1 0 1 1 0 :	Load CLUT Additional Colour-96..111	(each colour 2 bits)
55 = 1 1 0 1 1 1 :	Load CLUT Additional Colour-112..127	(each colour 2 bits)
56 = 1 1 1 0 0 0 :	Load CLUT Additional Colour-128..143	(each colour 2 bits)
57 = 1 1 1 0 0 1 :	Load CLUT Additional Colour-144..159	(each colour 2 bits)
58 = 1 1 1 0 1 0 :	Load CLUT Additional Colour-160..175	(each colour 2 bits)
59 = 1 1 1 0 1 1 :	Load CLUT Additional Colour-176..191	(each colour 2 bits)
60 = 1 1 1 1 0 0 :	Load CLUT Additional Colour-192..207	(each colour 2 bits)
61 = 1 1 1 1 0 1 :	Load CLUT Additional Colour-208..223	(each colour 2 bits)
62 = 1 1 1 1 1 0 :	Load CLUT Additional Colour-224..239	(each colour 2 bits)
63 = 1 1 1 1 1 1 :	Load CLUT Additional Colour-240..255	(each colour 2 bits)

ITEM-2 instructions, except 'MEMORY control' and 'Load CLUT Colour-0..7 and -8..15', are available only when the instruction 'MEMORY control' indicates '1-plane state'.

5. Channels R .. W

5.5.5.1 MEMORY control instruction (3)

If the instruction is 'MEMORY control', the format of the DATA-field in the PACK is :

Bit	R	S	T	U	V	W	
Symbol 4	0	0	D	M	W	M	DM = T U
5	0	0	D	M	W	M	0 0 : '1-plane state' (WM = 11 or 00)
6	.	.	.	.			0 1 : Display PRIMARY
7	.	.	.	.			1 0 : Display SECONDARY
.	.	.	.	.			1 1 : Additive mix (1:1) } '2-plane state'
.	.	.	.	.			
.	.	.	.	.			(DM = Display Memory)
.	.	.	.	.			V W
.	.	.	.	.			WM = 0 0 : Neither PRIMARY nor SECONDARY
.	.	.	.	.			0 1 : PRIMARY only
18	.	.	.	.			1 0 : SECONDARY only
19	.	.	.	.			1 1 : Both PRIMARY and SECONDARY
	.	.	.	.			(WM = Working Memory)

The instruction 'MEMORY control' is used :

- at the start point of every track,
- at the start and end of the "CUT" or "DISSOLVE" effect,
- at the start point of '1-plane state' or '2-plane state',
- at the end of a chain of 'Load CLUT Colour' and 'Load CLUT Additional Colour' instructions,

The last 'MEMORY control' instruction is defining which ITEM-1 instruction is active. Instead of using empty PACK's (MODE 0, ITEM 0) after the last 'MEMORY control' instruction, the last 'MEMORY control' instruction has to be repeated in subsequent empty packs.

The instruction 'MEMORY control' indicates :

- the attribute of 2 memories, i.e. 2 INDEPENDENT memories for 16-colour pictures ('2- plane state') or INDIVIDUAL memory for 256-colour pictures ('1-plane state').
- the selection of the display mode in the '2-plane state', i.e. from : PRIMARY MEMORY only, SECONDARY MEMORY only or additive mix of both memories.
- the memory to which instructions are addressed.

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The following table shows all possible combinations of DM and WM:

WM DM	00: no 'ITEM-1' instr. available	01: instr. work on PRIMARY M	10: instr. work on SECONDARY M	11: instr. work on both M
00	1-plane state no 'ITEM-1' instr.	no operation	no operation	1-plane state
01	display PRIMARY no instr. avail.	display PRIMARY work on PRIMARY	display PRIMARY work on SEC. M	display PRIMARY work on both M
10	display SEC. M no instr. avail.	display SEC. M work on PRIMARY	display SEC. M work on SEC. M	display SEC. M work on both M
11	display add-mix no instr. avail.	display add-mix work on PRIMARY	display add-mix work on SEC. M	display add-mix work on both M

'1-plane state' usage

- DM,WM' is '00,11': the PRIMARY MEMORY and the SECONDARY MEMORY form an 8-bit code to construct a 256-colour picture.

'Write Additional FONT' and 'X-OR Additional FONT' are affecting the SECONDARY MEMORY. 'Write FONT' and 'X-OR FONT' of ITEM-1 instructions are affecting the PRIMARY MEMORY. 'Soft scroll SCREEN' shifts the FONT-data of both memories together. The instructions: 'Preset MEMORY', 'Preset BORDER' or 'Soft scroll SCREEN with preset' give the 'COLOR' defined in the instructions to all FONTs of the PRIMARY MEMORY and give the data '0000' to all FONTs of the SECONDARY MEMORY.

The procedure to change the CLUT at once is :

- A chain of 'Load CLUT Colour' and 'Load CLUT Additional Colour' instructions for one picture is supplied in subsequent PACKs.
 - The 'MEMORY control' instruction for '1-plane state' is placed at the end of a chain of 'Load CLUT Colour' and 'Load CLUT Additional Colour' instructions, which activate the new CLUT contents.
- DM,WM' is '00,00': the PRIMARY MEMORY and the SECONDARY MEMORY form an 8-bit code to construct a 256-colour picture. ITEM-1 instructions are not effective in this mode. All ITEM-1 instructions are affecting a TV-Graphics decoder only. The displayed picture from the Extended TV-Graphics decoder is, however, not affected by ITEM-1 instructions.
 - DM,WM' is '00,01' or '00,10': are the no operation codes of the instruction 'MEMORY control', and the last 'MEMORY control' instruction is still effective.
-

5. Channels R .. W

'2-plane state' usage

The ITEM-2 instructions are not effective in this state, except the instructions: 'MEMORY control', 'Load CLUT Colour-0..7' and 'Load CLUT Colour-8..15', which are effective in both states.

DM (Display Memory) defines the memory to display:

- DM is '01': only the picture of the PRIMARY MEMORY can be seen on the display.
- DM is '10': only the picture of the SECONDARY MEMORY can be seen on the display.
- DM is '11': R,G,B data of both memories are simply added respectively. If the result of this addition is over '1111', the result should be represented by '1111'.

WM indicates the MEMORY/CLUT to be operated by the ITEM-1 instructions:

- WM = 00: no instruction is effective on either the PRIMARY MEMORY/CLUT or SECONDARY MEMORY/CLUT/BORDER, except 'MEMORY control'. ITEM-1 instructions are affecting a TV-Graphics decoder only.
- WM = 01: ITEM-1 instructions, 'Load CLUT Colour-0..7' and 'Load CLUT Colour-8..15' are affecting the PRIMARY MEMORY only.
- WM = 10: ITEM-1 instructions, 'Load CLUT Colour-0..7' and 'Load CLUT Colour-8..15' are affecting the SECONDARY MEMORY only.
- WM = 11: ITEM-1 instructions, 'Load CLUT Colour-0..7' and 'Load CLUT Colour-8..15' are affecting the PRIMARY MEMORY and the SECONDARY MEMORY.

5. Channels R .. W

5.5.5.2 Write Additional FONT FOREGROUND/BACKGROUND instruction (6)

If the instruction is 'Write Additional FONT FOREGROUND/BACKGROUND', the format of the DATA-field in the PACK is :

Bit	R	S	T	U	V	W
Symbol 4	CH 0		COLOR0			
5	CH 1		COLOR1			
6	0	ROW				lsb
7	COLUMN					lsb
8	y FONT z					
.						
.						
.						
.						
19						

COLOR0 : background colour number 0 .. 15 (lsb on W)

COLOR1 : foreground colour number 0 .. 15 (lsb on W)

ROW = 0 .. 17 }
 COLUMN = 0 .. 49 } address of additional FONT

CH0/1 = 0 .. 15: channel number
 (msb on R of symbol 4, lsb on S of symbol 5)

FONT : y = top left pixel in the FONT.
 z = bottom right pixel in the FONT.
 Pixel with value = 0: background colour (COLOR0)
 = 1: foreground colour (COLOR1)
 COLOR0/1 : lsb = bit plane-0
 msb = bit plane-3

5. Channels R .. W

The instruction 'Write Additional FONT FOREGROUND/BACKGROUND' writes one FONT with the data defined in 'FONT' and the colours defined in COLOR0 and COLOR1 into memory. The data in FONT is written at address [ROW, COLUMN] in bit planes 0..3 of the SECONDARY MEMORY.

The number CH gives a channel number to a FONT with data. The concept of a channel is the same as for TV-GRAPHICS. The FONT data and the Additional FONT data of one picture have the same channel number.

5. Channels R .. W

5.5.5.3 EXCLUSIVE-OR Additional FONT with 2 colours instruction (14)

If the instruction is 'EXCLUSIVE-OR Additional FONT with 2 colours', the format of the DATA-field in the PACK is :

Bit	R	S	T	U	V	W
Symbol 4	CH 0		COLOR0			
5	CH 1		COLOR1			
6	0	ROW			lsb	
7	COLUMN				lsb	
8	y FONT z					
.						
.						
.						
.						
.						
19						

COLOR0/1 : Colour number 0 .. 15 (lsb on W)

ROW = 0 .. 17 }
 COLUMN = 0 .. 49 } address of additional FONT

CH0 = 0 .. 15: channel number
 (msb = on R of symbol 4, lsb on S of symbol 5)

FONT : y = top left pixel in the FONT.
 z = bottom right pixel in the FONT.
 Pixel with value = 0: X-OR the colour number of this pixel
 with the number 'COLOR0'
 = 1: X-OR the colour number of this pixel
 with the number 'COLOR1'

The instruction 'EXCLUSIVE-OR Additional FONT with 2 colours' X-ORs the colour values of pixels in FONT [ROW,COLUMN] with the numbers given in COLOR0 and COLOR1. The result of this action is stored at memory address [ROW,COLUMN].

The number CH gives a channel number to a FONT with data. The concept of a

5. Channels R .. W

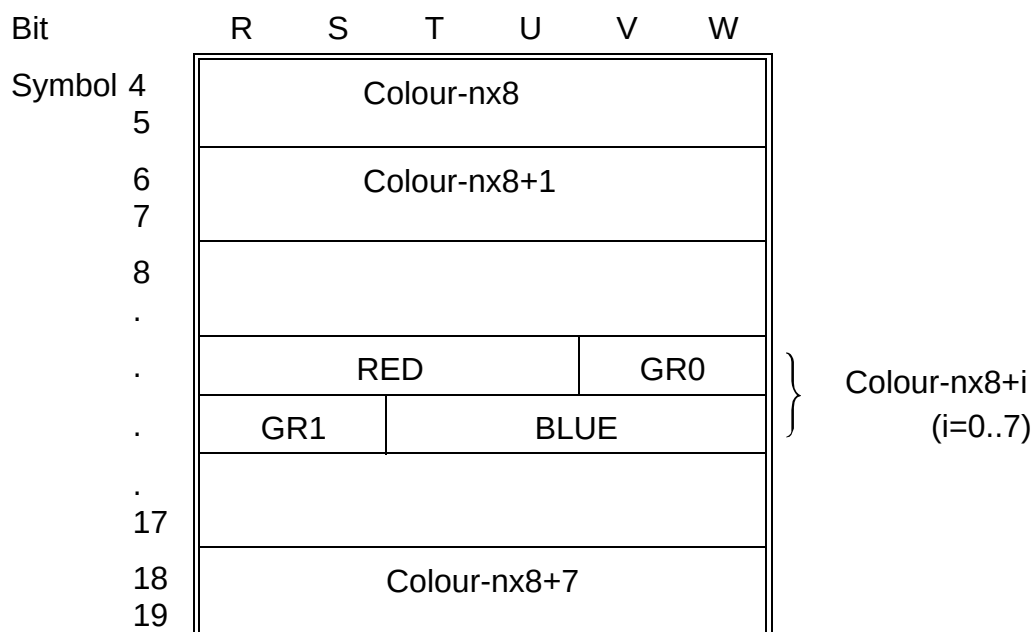
channel is the same as for TV-GRAPHICS. The FONT data and the Additional FONT data of one picture have the same channel number.

If a pixel in FONT has value '0', the 4 bits in the memory for this pixel are X-ORed with the 4 bits given in COLOR0. If a pixel in FONT has value '1', the 4 bits in the memory for this pixel are X-ORed with the 4 bits given in COLOR1.

5. Channels R .. W

5.5.5.4 Load CLUT Colour instructions (16-47)

If the instruction is 'Load CLUT Colour-(nx8..nx8+7), [n=0..31], the format of the DATA-field in the PACK is :



RED	:	red component	(msb on bit R)	} (even symbols)
GR0	:	} green component	(msb on bit V)	
GR1	:		(lsb on bit S)	
BLUE	:		blue component	(msb on bit T)

The instruction 'Load CLUT Colour-(nx8..nx8+7)' loads 12-bit data consisting of upper 4 bits of R,G,B, 6 bits each, for every 8-colour group.

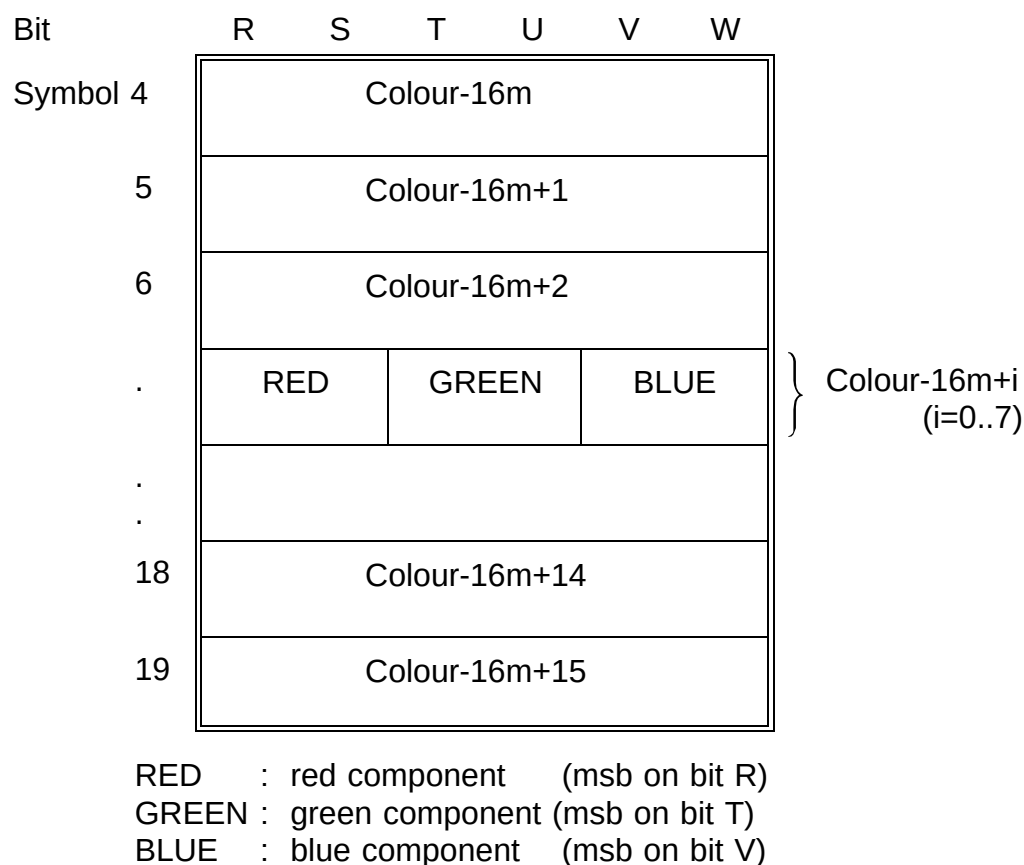
One instruction handles (8/256 x 12/18) of the Colour Look Up Table. The CLUT has to be reloaded completely after changing from '2-plane state' to '1-plane state'. The 'MEMORY control' instruction: '1-plane state' is used for both indicating "state change" and indicating the end of a chain of 'Load CLUT Colour' and 'Load CLUT Additional Colour' instructions.

'Load CLUT Colour-0..7' and 'Load CLUT Colour-8..15' are used in the '2-plane state'. These two instructions are used for a 'DISSOLVE' effect by changing both CLUTs.

5. Channels R .. W

5.5.5.5 Load CLUT Additional Colour instructions (48-63)

If the instruction is 'Load CLUT Additional Colour-(16m..16m+15)' [m=0..15], the format of the DATA-field in the PACK is :



The instruction 'Load CLUT Additional Colour-(16m..16m+15)' loads 6-bit data consisting of the lower 2 bits of R,G,B, 6 bits each, for every 16-colour group. One instruction handles (16/256 x 6/18) of the Colour Look Up Table. The CLUT has to be reloaded completely after changing from '2-plane state' to '1-plane state'. The 'MEMORY control' instruction : '1-plane state' is used for both indicating "state change" and indicating the end of a chain of 'Load CLUT Colour' and 'Load CLUT Additional Colour' instructions.

Appendix 5. Channels R - W

5.6 The MIDI mode (MODE = 3, ITEM = 0)

5.6.1 General

The MIDI mode is a transparent data channel with a maximum data rate of 3125 bytes per second intended for Musical Instrument Digital Interface (MIDI) data as specified by the International MIDI Association¹.

5.6.2 The MIDI mode PACK format:

Bit		R	S	T	U	V	W		
Symbol	0	0	1	1	0	0	0		
	1	0	0	BYTES					
	2	PARITY Q0							
	3	PARITY Q1							
	4	B1							
	5								
	6								
	7	B2				B3			
	8								
	9	B4				B5			
	10								
	11	B6				B7			
	12								
	13	B8				B9			
	14								
	15	B10				B11			
	16								
	17	B12							
	18								
	19								
	20	PARITY P0							
	21	PARITY P1							
	22	PARITY P2							
	23	PARITY P3							

BYTES = 0..12 (lsb on bit W)
No. of MIDI bytes in PACK

B_n = n-th MIDI byte in PACK
(msb on R, T or V,
lsb on S, U or W resp.)

¹ See publication "MIDI 1.0 Detailed Specification"

Appendix 5. Channels R - W

The number of MIDI bytes in a pack is indicated by BYTES (four bit binary). All bits of unused bytes are zero.

Any 12 consecutive packs may contain no more than 125 MIDI bytes. If playback on equipment with up to +12.5% pitch control is envisaged it is recommended to limit the data rate to a maximum of 110 bytes in any 12 consecutive packs.

It is recommended that a CD player equipped with a MIDI output generates an All Notes Off message when the MIDI sequence is interrupted by the user (stop, pause, previous, next, scan).

5.7 The USER mode (MODE = 7, ITEM = 0)**5.7.1 General**

The USER mode is a "user" data channel intended for use by professional CD users.

5.7.2 The USER mode PACK format

Bit	R	S	T	U	V	W
Symbol 0	1	1	1	0	0	0
1	INSTRUCTION					
2	PARITY Q0 PARITY Q1					
3						
4	DATA field					
.						
.						
.						
.						
.						
.						
.						
.						
.						
.						
.						
.						
19						
20	PARITY P0 PARITY P1 PARITY P2 PARITY P3					
21						
22						
23						

INSTRUCTION }
DATA field } Defined by the user

Appendix 5. Channels R - W

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A 5.4 TV-GRAPHICS mode implementation aspects

1 Data speed

The maximum speed of the TV-GRAPHICS data is 300 PACKS per second. For TV-GRAPHICS a picture in most cases will be displayed 50 (PAL/SECAM) or 60 (NTSC) times per second (not interlaced video). As a result of this new data and the update of the screen pointers will be visible maximum 50 (or 60) times per second.

2 Graphics and soft scroll

Soft scroll is made possible by a POINTER system. For the LINE-GRAPHICS system the available pointers and their general behaviour are described in chapter 5.3.4. For the TV-GRAPHICS system the pointers are described in chapter 5.4.4.

To illustrate the behaviour of the soft scroll pointers a few possible pointer sequences are given below for the TV-GRAPHICS system.

Scroll SCREEN

	←-----Scroll left-----→										←-----Scroll right-----→																
	←--- fast ---→					←----- slow -----→					←--- fast ---→																
PH	=	2	4	0	2	4	0	1	2	3	4	5	0	1	2	1	0	5	4	3	2	1	0	4	2	0	4
COPH	=	0	0	2	0	0	2	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	1	0	0	1
PV	=	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COPV	=	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preset																											

The CHANNEL number gives a software manufacturer the possibility to split up a picture into maximum 16 sub-pictures. A sub-picture (marked by a channel number) can use FONTS with any position on the screen. Data with different channel numbers can have the same position on the screen, this can make sense if a few sub-pictures are used to give different languages.

A software manufacturer has to create the default picture with the CHANNELS 0 and 1. By using two channels for the default picture, he can split up the default picture into text and other graphics information. This gives the user at the display side the possibility to select from the default display information text only or picture only if the channels 0 and 1 are used in this way.

CHANNEL 0 English text of the song
CHANNEL 1 Pictures illustrating this song (flowers, etc.)
CHANNEL 2 Japanese translation of the text
CHANNEL 3 Phonetic version of the Japanese text
CHANNEL 4 French translation of the text
CHANNEL 5 Music notes
CHANNEL 6 Dancing feet
CHANNEL 7 Word pointer for the English text
CHANNEL 8 German translation of the text
CHANNEL 9 .. 15 Not used.

On a decoder with selection possibilities, any combination of the channels 0 ... 8 can be displayed with this disc.

The FONT data of the not selected channels can be ignored, otherwise a huge amount of memory would be necessary in the graphics decoder.

Appendix 5.5 EXTENDED TV-GRAPHICS mode implementation aspects**1 Memory organization** (see Figure 1)

Both the PRIMARY MEMORY and the SECONDARY MEMORY have 300 (pixels) x 216 (lines) or [50 x 18 FONTS]. The pixels are coded with a 4-bit code, which is the colour address of the C(olour) L(ook) U(p) T(able). Each of the two BORDERS is defined independently by the colour.

2 Video effects "CUT" and "DISSOLVE"

The 4-bit code from each memory defines the address of the CLUT for 16-colour pictures independently. The change from one 16-colour picture to another gives the 'CUT' effect. The additive mix of two 16-colour pictures gives the 'DISSOLVE' effect by changing the CLUT, using 'Load CLUT colour-0..7 and -8..15' in ITEM-1 and 'Load CLUT colour-0..7 and -8..15' in ITEM-2, because of compatibility with TV-GRAPHICS decoders.

3 CLUT Organization (see Figure 2)

The CLUT consists of the 256-colour number which has R,G,B, 6 bits each. The instruction 'Load CLUT Colour' gives the upper 4 bits of the '6 bits' to each group of 8 colours.

The instruction 'Load CLUT Additional Colour' gives the lower 2 bits of the '6 bits' to each group of 16 colours.

The 32 'Load CLUT' instructions define the 256-colour number. Two 'Load CLUT' instructions are in ITEM-1. The remaining 30 are in ITEM-2. Two instructions: 'Load CLUT Colour-0..7 and -8..15' in ITEM-2 are used for a 'DISSOLVE' effect in the 2-plane state.

The 16 'Load CLUT Additional Colour' instructions define the 256-colour number and are in ITEM-2.

When changing the mode from '1-plane state' to '2-plane state', the CLUT data should be reloaded with the ITEM-1 instruction 'Load CLUT'.

In the '1-plane state', the colours of colour number 0..15 on the 16 x 16 CLUT must be loaded at least once by 'Load CLUT' in ITEM-1. Colour number 0..15 are then ready for loading by 'Load CLUT Colour 0..7 and -8..15' in ITEM-2.

4 Changing one colour out of 256 colours

Both 'Load CLUT' and 'Load CLUT Additional Colour' instructions are required to change only one colour out of the 256 colours.

When changing any eight colours selected from the 256 colours, from one to eight pairs of the above instructions are required.

5 The relationship between colour numbers in '1-plane state' (see Figure 3)

The ITEM-1 instructions: 'Load CLUT Colour 0..7' and 'Load CLUT Colour 8..15' determine the 16 colours with R,G,B, 4 bits each. A TV-GRAPHICS decoder represents pictures with these 16 colours and ignores any other 'Load CLUT Colour' or 'Load CLUT Additional Colour' instructions.

The procedure to determine the colour to the CLUT is, e.g. as follows:

First of all, the 16 colours of R,G,B, 4 bits each are selected from the original images. These 16 colours are allocated with colour numbers 0-15. The picture consisting of these 16 colours is for the TV-GRAPHICS picture.

Secondly, in the area of every colour number for the TV-GRAPHICS picture, the 16 colours of R,G,B, 6 bits each are selected from the original images.

The colours of the colour number with the same lower 4 bits represent near colour tones.

6 Compatibility with TV-GRAPHICS decoders

A TV-GRAPHICS decoder represents a 16-colour picture out of a 256-colour picture and executes no video effects "CUT" or "DISSOLVE", because it has only one memory plane.

The lower 2 bits of R,G,B, 6 bits each are ignored, even if the picture consists of 256 colours in the EXTENDED TV-GRAPHICS format.

The video effects "CUT" or "DISSOLVE" are not executed by a TV-GRAPHICS decoder.

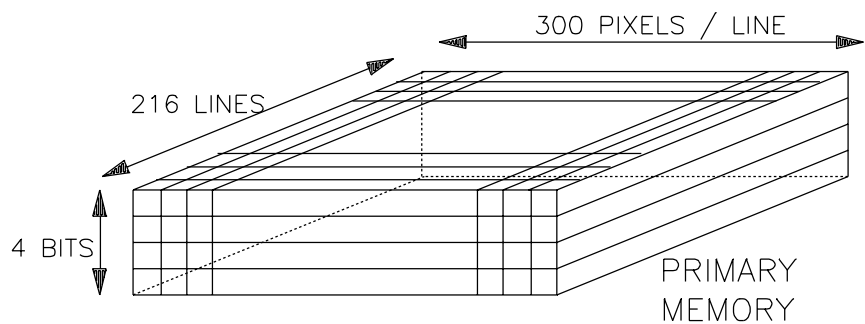
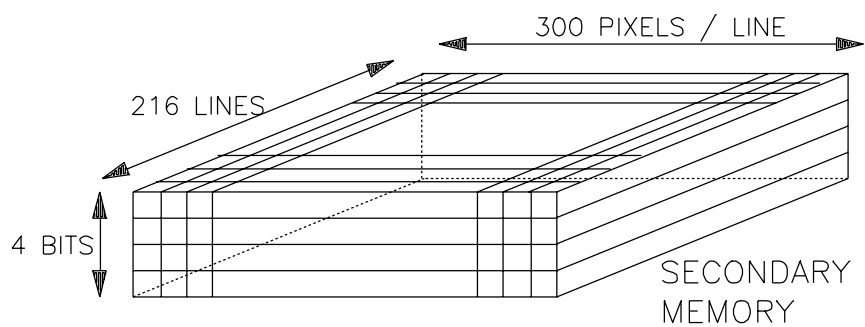
When the instruction 'MEMORY Control' indicates '1-plane state', the PRIMARY MEMORY and CLUT 0-15 construct a 16-colour picture in the TV-GRAPHICS decoder.

7 Difference of decoder output signal level between 4-bit data and 6-bit data

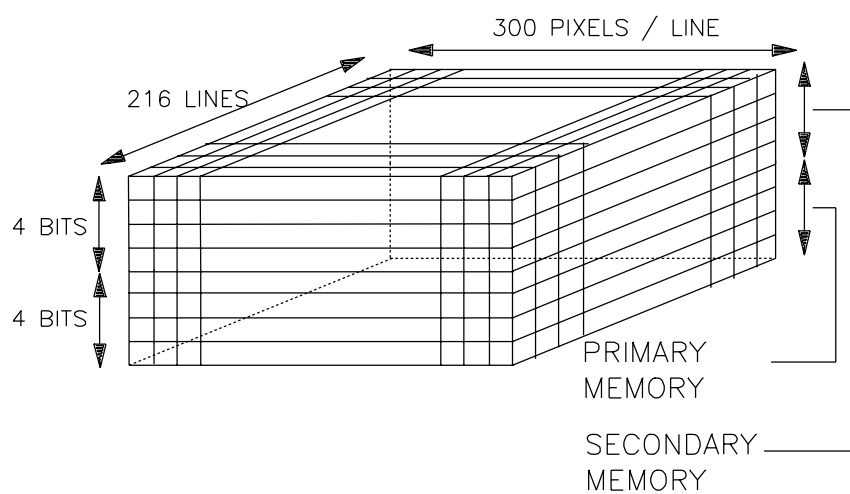
The dynamic range of the decoder output signal level is different between 4-bit data of 16-colour pictures and 6-bit data of 256-colour pictures.

One way to correct the level is to attenuate the video signal. Another way is to add a suitable fixed data to the lower 2 bits. The fixed data is recommended to be '10' as a balance between 'white peak' and 'set-up level'.

Figure 1 Memory Organization of EXTENDED TV-GRAPHICS



a) Two memory planes of 16 colours



b) One memory plane of 256 colours

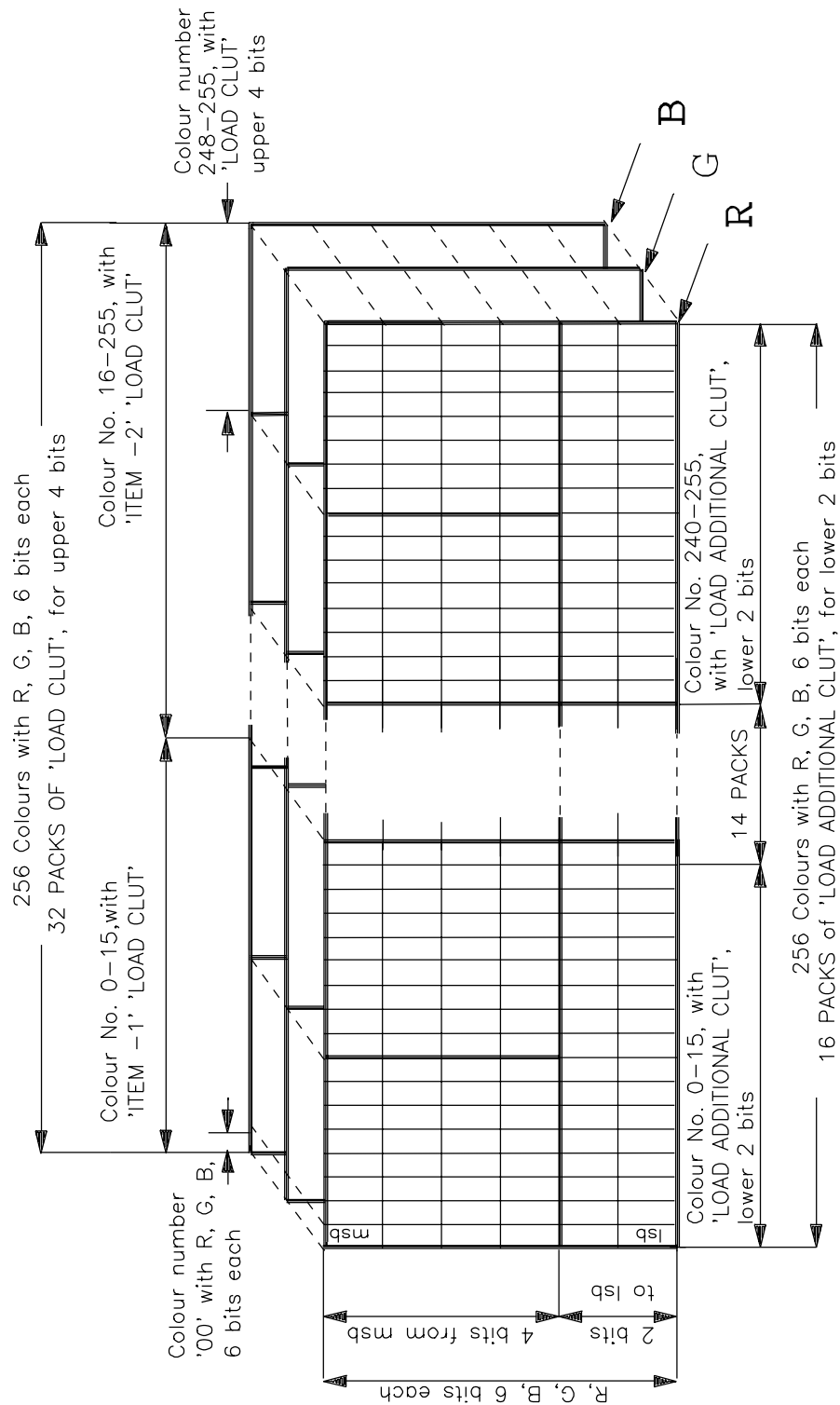
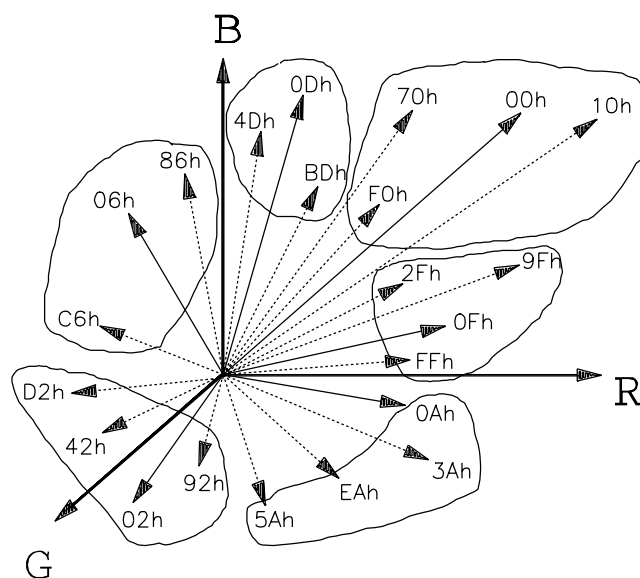
Figure 2 CLUT structure of EXTENDED TV-GRAPHICS

Figure 3 Relationship of colours between TV-GRAPHICS and EXTENDED TV-GRAPHICS



TV-GRAPHICS
can display
(16 colours:
by ITEM-1:
lsb's/4 bits)

EXTENDED TV-
GRAPHICS
display
(256 colours:
by ITEM-1/2:
8 bits)

